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Issue Paper I

THE NECESSITY OF AN INTEGRATED APPROACH TO FERTILIZER PRODUCTION AND USE IN AFRICA*

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1. Introduction and summary

The complexity of African agriculture is being increasingly subjected to expert scrutiny.

Concerned governments and the international community have demonstrated a profound anxiety regarding, and a painful awareness of, the plight confronting millions of persons. As a result, there is no scarcity of general prescriptions and policy guidelines designed to alleviate the crisis of famine.

The Food and Agriculture Organization of the United Nations has recently published the findings of a major study on African agriculture and its prospects for the next 25 years. 1/ The report is centered on an in-depth investigation of the underlying causes of the decline, which, contrary to conventional wisdom, has been in the making for at least two decades. The study also assesses in detail Africa's potential for recovery and analyses the ways to mobilize the necessary resources.

The many factors contributing to the difficulty of securing growth in African agriculture are not always fully understood in their manifold interactions. Obviously these factors cover a wide range, from government policies and resource endowment to the adequacy of input supplies and the efficiency of the economic environment in which farmers and traders have to operate.

For these reasons, it would be pretentious and misleading to prescribe simplistic remedies or even to predict structural changes as a result of implementing such recommendations.

Nevertheless, even a cursory knowledge of the peculiarities of African agriculture should rule out any attempt to transfer the impressive experience of Asia's so-called "green revolution" in view of the fundamental differences in the ecology and culture of the continent. Moreover, Africa cannot be treated as a whole, so that country or regional analysis is inevitable.

It is, however, widely recognized that among all the external inputs to agriculture designed to increase crop productivity, chemical fertilizers figure most prominently. Therefore, the role of plant nutrients (nitrogen, phosphates and potash) is indispensable in any strategy to boost agricultural output. Increased fertilizer use has undoubtedly been one of the main reasons behind the growth of some developing countries' agriculture in recent years.

The intention of this paper is not to duplicate similar efforts in the past by launching yet another investigation into the root causes of the stagnation in African agriculture, but rather to recapitulate systematically and focus on those factors that, taken together, have inhibited a wider and more efficient use of fertilizers in Africa. At the conclusion, suggestions are made for removing these obstacles through what must necessarily be an integrated approach consisting of complementary measures to promote the use of these chemicals on the continent. It should be recalled that Africa's insufficiency in food production, however alarming its current proportions, is still perfectly capable of a rapid and catastrophic further deterioration if current trends are not arrested and ultimately reversed.

1/ African Agriculture: The Next 25 Years (Food and Agriculture Organization of the United Nations).

2. Current obstacles to the use of fertilizers

2.1 Agricultural pricing policies and subsidies

Price support practices for crops and fertilizers

The prices of agricultural products are often not high enough to encourage farmers to use fertilizers, which are frequently very expensive. Among the most striking examples of non-remunerative price relationships in Africa, the cases of Ethiopia and Zambia might be mentioned. In these two countries, farmers selling their grain harvests to official agencies in the early 1980s were being paid about one half of the 1970s price in constant terms.

These policies mainly affect products intended for export, but also affect those destined for the internal market. The result of this is that the urban population often benefits from artificially low price levels to the detriment of farmers. As a consequence, rural exodus to the cities is accelerated, permanently depriving the agricultural sector of part of its work-force.

Often, local production also suffers from subsidies for imported agricultural commodities, making it less competitive. On the other hand, subsidies that are granted by governments for imported fertilizers do not always encourage consumption in the intended way and may discourage local fertilizer production.

In this way, pricing and subsidy policies often inhibit both the use and production of fertilizers.

Loans, incentives and credits

Few farmers have sufficient savings to enable them to purchase fertilizers several months before they are paid for their harvests; in addition, they frequently experience difficulties in obtaining credits.

Because the relevant financial institutions are under-resourced and often inefficiently managed, loan applications are refused to farmers who own small holdings, to women who manage their farms on their own and to share-croppers. Some farmers have no access to credit facilities simply because they are located too far away from the financial institutions.

Finally, in most African States, there are no preferential loans or subsidy policies destined for agriculturalists.

The farmers' terms of trade

Since the beginning of the 1980s, the terms of trade for African exporters of agricultural commodities have been detrimentally affected by the decline in prices and the stagnation in volume of sales. At the same time, the prices of imported products have continued to increase.

This deterioration of the terms of external agricultural trade (about 10 per cent in 1985 and certainly more in 1986, according to FAO) contributed to worsening the liquidity of farmers, all the more as governments did not provide sufficient support; the situation is especially difficult for

small-scale farmers and in particular for the share-croppers who pay for all of their inputs, including fertilizers, while being compensated for only part of what they produce.

2.2 Physical and environmental conditions

Nutrient depletion and soil erosion

One of the major problems of the African agriculture is permanent soil deterioration (erosion and depletion of nutrient content), attributable to many factors, among them reduced arable acreage as a result of population growth, overworking of the available land and insufficient soil management. Losses are sizeable and contribute to reducing income available for purchasing fertilizers. For example, each year Zimbabwe loses 15.6 million tonnes of organic matter, 1.6 million tonnes of nitrogen and 240,000 tonnes of phosphorus due to top soil erosion. The use of fertilizer in sufficient quantities to replace these losses would cost some $1,500 million per year. The estimated cost of the erosion is put at $20-$50 per cultivated hectare. Insufficient fertilizer use favours soil depletion, bringing about a reduction in yields and consequently in fertilizer purchases, and finally further soil deterioration.

Irrigation and water management

Inadequate water resources and irrigation systems also constitute a major obstacle to African agriculture and to fertilizer use, as fertilizers are inefficient if not used with adequate irrigation. Africa has vast deserts (30 per cent of the total surface), tropical regions (overabundant rainfall) and very often irregular rainfall. Added to these are financial constraints, insufficient skilled personnel and other constraints to the improvement of irrigation systems. These conditions only increase the farmer's desire to reduce risks to all kinds of capital exposure, and specifically to fertilizer purchases.

Pre- and post-harvest losses

Farmer income is also diminished because of large production losses occurring before and after harvest. Pre-harvest losses may amount to as much as 30 per cent of production. The plants suffer from drought and insect attack. The irrigation systems and use of pesticides are often insufficient to limit this damage.

Following harvest, the crops are further diminished as a result of poor handling, processing and inappropriate storage. There is a lack of processing facilities, silos and know-how. In some countries (the Sahel) these losses may amount to as much as 40 per cent of production.

2.3 Effectiveness of fertilizer application

Paucity of agronomic data for proper fertilizer use

In Africa, agronomic testing to detect soil deficiencies and determine crop requirements for fertilizers under varying soil management and climatic conditions remains rudimentary, thus diminishing the potential benefit of

fertilizer use, which has to be convincingly demonstrated to the farmer through trials on his field. Moreover, research is more oriented to drought- and disease-resistance than to fertilizer responsiveness. African soils vary greatly in their physico-chemical properties, composition and reaction to external nutrition. It would therefore be difficult to formulate an integrated plant nutrition approach. Further difficulties come from:

(a) Inadequate field of experimentation based on agronomic data;

(b) Lack of appropriate application technologies;

(c) Failure to observe requirements of integrated plant nutrition;

(d) Absence of the required balance between plant nutrients in fertilizer products;

(e) Non-optimal application rates and schedules;

(f) Lack of adequate irrigation and related facilities.

Unavailability of required fertilizer types

In order to be effective, the fertilizers used must be the right kind for the plants and soils in question and must be applied according to the prescribed schedules. This implies a knowledge of the nature, frequency and quantity of fertilizer requirements and scrupulous adherence to them. However, as already pointed out, the data to permit identifying these requirements and the infrastructure to allow satisfying them, are inadequate.

By way of example, mention might be made of the phosphate fertilizers sold to Mali and to Burkina Faso. These locally produced fertilizers were presented in a powdery form, which was not popular with the farmers because of the associated dust, and they soon stopped using them.

In Niger, a fertilizer produced from the output of the Tahoua phosphate deposits was marketed, but it was found to be totally ineffective for local soils and crops. Despite subsidies, the farmers either refused it outright or else used it to give a pebble-dash finish to the walls of their houses.

Shortcomings of agricultural extension services

The role of the extension services is, in principle, to assist farmers in modernizing their farms. They do this by acting as an intermediary in the transmission of information between the agricultural sector and other sectors of the economy, specifically industry and the research community. Accordingly, these services should contribute to the more extensive use of fertilizers by informing farmers about the varieties to be used and the methods of application and by helping them to obtain the necessary resources to this end.

In point of fact, the extension services rarely perform this basic mission, for two main reasons:

(a) In the first place, the services lack resources: the personnel, who are too few, have not received the proper training and are poorly paid. Moreover, the agents do not have available the necessary equipment (they lack, for example, vehicles to enable them to maintain contact with all the farmers they are supposed to be serving);

(b) In the second place, the role of these services is poorly defined. The initial objective described above usually runs into a major difficulty - the lack of development in the other sectors mentioned. As a result, extension services have gradually been transformed into sales promotion agencies, particularly for agricultural exports.

The consequence is that the extension services are hardly participating in the effort to encourage the use of fertilizers. Instead, they frequently concentrate their efforts on a small number of farmers, namely the wealthiest and the best educated. Thus, extension workers are largely unfamiliar with farmers' grass roots problems and are not in a position to interact with the research community.

2.4 Technological and socio-cultural factors

Agricultural techniques

The use of machinery is an essential element in developing the use of fertilizers, which require additional work. Without machines to help, the farmer would regard this work as excessive in comparison with the benefits he expects to derive from it.

As it happens, the growth rate in agricultural mechanization in Africa is the lowest in the world. Between 1980 and 1983, Africa recorded the lowest rate of increase in the number of tractors; the figure was five times lower than that for Latin America and ten times lower than that for the Far East.

Apart from the large plantations whose output is intended for export (cacao, cotton etc.), little use is made of machines, and farmers continue to adhere to very traditional cultivation methods. Many operations are performed by hand. In some areas, not even animal traction is used. The purchase of machinery entails a sizeable investment beyond the means of most farmers.

The problem is compounded by the lack of appropriate application technologies that take into account the specific socio-cultural requirements of the African farmer. The conventional methods of fertilizer use have been developed and refined for an entirely different communications system. The transfer and absorption of technology for fertilizer application constitutes a major stumbling-block to the increased use of fertilizers in most rural communities on the continent and poses a serious challenge to the agricultural extension services.

Lack of skilled manpower

A skilled manpower shortage affects most sectors of African economies and specifically agriculture. This is due to the lesser development of local training facilities and insufficient support from the governments as compared to other sectors. The number of persons trained is very small in relation to the importance of agricultural development in Africa. According to a 1983 IBRD survey, 1 per cent of African students were pursuing training in the field of agriculture and only 0.14 per cent of the population employed in the agricultural sector had received any training at all.

Another point to be emphasized is that the few training programmes that do exist are not geared to meet the real requirements. There is a lack of

personnel trained locally and capable of dealing effectively with all stages of the agricultural process - input procurement, production, marketing and distribution.

The traditional monoculture system

One of the charateristics of African agriculture is the large-scale monoculture system inherited from the colonial period. This system provides large volumes of export products: tea in Kenya, cacao in Côte d'Ivoire, tobacco in Malawi, cotton in the Sudan etc. The sale of these products is frequently the principal source of income for African countries. Under a short-term strategy aimed at ensuring foreign exchange revenue, efforts are principally focused on improving monoculture yields. However, over the longer term, a systems approach involving all the technical and socio-economic aspects of agriculture could be more appropriate.

Orientation to monoculture farming neglects such important elements as:

(a) Deterioration of the soils caused by the monoculture system;

(b) Continued export dependence both at the level of the individual farmer and at the national level;

(c) Adaptation of production to local demand.

All of these elements would justify priority being given to research into the possibilities of crop diversification as a function of production constraints and consumption requirements.

Foreign exchange and external trade

Since the beginning of the 1980s, African countries have suffered from an increasing shortage of foreign exchange with which to finance their fertilizer imports. This is due to the concurrence of a number of factors that have curtailed their foreign exchange revenues from their commodity exports. Essentially, there are four such factors:

(a) The decline in prices and in the trading volumes of raw materials, which are the principal export items of African countries;

(b) Protectionist measures introduced by the developed countries;

(c) Competition of other developing countries. The Asian countries, in particular, have gained control of market segments that previously belonged to the African countries;

(d) Wide fluctuation in foreign exchange parities.

As a consequence, Africa's imports of fertilizers stagnated between 1982 and 1986 at a level slightly above 1 million tonnes per year. By way of comparison, it is worthwhile noting that during the same period, imports of fertilizers by the developing countries of the Far East nearly doubled, increasing from 3.8 million tonnes in 1982/83 to 6.4 million tonnes in 1984/85, despite a sizeable increase of their domestic production.

Transportation and marketing

Fertilizers are heavy and bulky products that must be delivered to the farm in large quantities and on pre-agreed dates. Their use depends to a significant degree on the transport and distribution infrastructure, which in Africa is usually inadequate.

The transport networks are not extensive enough. Many regions are isolated, especially in land-locked countries. Overland communication routes usually converge on the ports, and there is an acute lack of regional and interregional transport arteries. The existing communication routes are rudimentary. In the countryside, these are most often simple trails, unsurfaced and unmaintained.

In recent years, transport problems have grown worse. The governments lack the foreign exchange with which to import machinery and spare parts and they lack the know-how required for the construction of new roads and the maintenance of the existing networks. As a consequence, regions with no access to efficient, all-year-round transport systems are unable to obtain fertilizers.

2.5 Insufficient domestic production and related supply constraints

Domestic production of fertilizers

There are many possibilities in Africa for the production of fertilizer, particularly from phosphates. In fact in 1985, Africa furnished 44 million tonnes of natural phosphates, or 32 per cent of world production, with north western Africa alone accounting for 20 per cent of world production. The main deposits in operation are located in Morocco, Tunisia and Algeria, but there are also some in Togo, Senegal, Egypt, Uganda, Angola, Zimbabwe and South Africa. Many other countries have workable sites. However, these assets are substantially underworked for the production of fertilizer.

There are a number of problems inhibiting the development of fertilizer production on the continent. Fertilizer production plants are capital-intensive because they require sophisticated technology. The costs are particularly high in Africa owing to the scarcity of a number of production factors. Often the shortage of trained local manpower makes it necessary to hire foreign experts. Similarly, most of the equipment and machinery has to be imported. The inadequacies of the infrastructural systems impose additional costs. The investments are all the more burdensome in that the essential items must, as a general rule, be paid for in foreign exchange.

Cost of fertilizer production

The phosphate fertilizer production units in Africa are operating at substantially less than full capacity. During 1985-1986, phosphate fertilizer production was only 34 per cent, on average, of the installed capacity for the entire continent. Utilization rates range from 70-80 per cent (Senegal, Zimbabwe and Egypt) to only 8 per cent (Tanzania). Morocco, with more than half of Africa's installed production capacity, used only 20 per cent of that capacity.

Numerous projects have been delayed or cancelled because of excessive costs, particularly when the building of the plant also required the establishment of infrastructural facilities. This happened, for example, in the case of the phosphate recovery projects at Abu Tartur (Egypt), Loubloïra and Bofal (Mauritania) and Matam (Senegal).

Potential of domestic markets

One of the main reasons for the under-utilization of production capacity is the insufficient absorptive capacity of the national markets. During the period 1984-1985, the consumptic of phosphate fertilizer in Africa was less than 0.6 million tonnes as against a production capacity of about 2.5 million tonnes. Fertilizer consumption in Africa per cultivated hectare is extremely low; in 1985, it stood at about 11 kg per cultivated hectare (4 kg of this amount being in the form of phosphate fertilizer) as opposed to 189 kg per cultivated hectare in Asia and 240 kg in Europe.

This inadequacy of local demand provides little incentive to increase domestic supplies. In particular, it also makes it difficult to achieve economies of scale at the production units, although such economies are essential if producers are to be able to compete with imported fertilizers. In certain cases, this competition is all the more keen because imported fertilizers receive government subsidies.

3. Measures to increase fertilizer use

3.1 Agricultural adjustment policies

Remunerative agricultural prices

Price- and subsidy-based agricultural adjustment policies are extremely complex. They vary more in their methods than in their objectives, changing to suit different situations at different times. The main purpose of such policies is to guarantee sufficient income for the producer by taking into account production costs, consumer income and international prices (often influenced by currency fluctuations).

Adjustment policies such as subsidies for production inputs are often criticized. On the one hand, they occasionally give rise to patterns of production contrary to economic rationale and produce protectionist effects, but on the other hand, they are costly and difficult to modify or eliminate. However, they should not be rejected a priori: they often support local fertilizer production and are effective when there is under-utilized production potential and they are also complementary to overall agricultural policies.

A price guaranteeing both the farmer and the fertilizer producer a sufficient return makes it possible to increase consumption, improve the distribution system and, in the final analysis, achieve greater productivity. The best solution is obviously to be able to set a price that is both close to the international market price and that ensures the farmer an acceptable return. If this cannot be done, other instruments of economic policy may be employed. Protectionist duties may be introduced to discourage the consumption of imported products. Devaluations have also been used to

increase the prices of imported products, making local production more competitive. In this case, however, subsidies must be introduced for the imported inputs, which otherwise become too expensive. And, as far as fertilizers and other agricultural inputs are concerned, the risk exists that local fertilizer producers may be put at a disadvantage.

Price and subsidy policies are interconnected. Moreover, since the farmers, located as they are at the centre of the circuit, are simultaneously producers and consumers, it is clear that adjustments have to be primarily based on demand for agricultural products and the demand for fertilizers. A production potential exists in Africa. The problem is to stimulate the demand.

Risk-sharing schemes and credit facilities for farmers

The fact that agricultural production in Africa involves great fluctuations in income and a very high level of risk means that it is necessary to share the risks but difficult to find partners willing to do so. By bringing farmers together in farming communities, it is possible to cut down on certain investment costs (inputs and machinery) and to mitigate the effect of any losses that may arise.

Another step might be to develop a kind of public insurance to cover harvests. Instead of systematically allocating input subsidies, the government could compensate a part of the input costs in the event of a bad harvest.

Credit facilities could also be extended in order to enable farmers to cope with the sizeable investments by the use of fertilizers. This implies the need to reorganize the banking system, improve the management and decentralize credit institutions by setting up more offices within rural communities.

There must also be a diversification in the available forms of credit. For example, the banks could offer credit contracts for the purchase of fertilizer, providing for repayment out of income derived from the sale of the next harvest. Following the same principle, it should be possible to develop credit suppliers, with the supplier delivering fertilizer before the harvest, to be paid for once the harvest has been sold.

Role of co-operatives, farmers' associations and producer organizations

Farmer associations, just like fertilizer producer associations, make it possible to introduce production rationalization measures both upstream and downstream: combined fertilizer orders reduce costs through more favourable prices and reduced transport expenses. Jointly owned machinery, tractors and storage as well as the rationalization of product marketing and distribution, help to lower prices and reduce fixed costs. Associations are also information exchange centres. Governments should therefore encourage the formation of these groups through financial assistance and tax incentives.

3.2 Improving the input supplies to agriculture

Small-scale fertilizer production and blending units

Small-scale fertilizer manufacturing plants offer a number of advantages. They develop local industry, they allow foreign exchange savings, they are better suited to an underdeveloped economic fabric, they adapt better to local demand and, most importantly, they entail less capital expenditure.

Africa has a great potential, especially for phosphates: small-scale production units could be installed, after careful study (raw material availability, local demand), in major producer countries, such as Morocco, Algeria and Tunisia, or in countries with modest levels of production or none at all, such as Mauritania, Niger, Senegal, Mali and Togo.

Over the long term, the establishment of a series of small production units would be the best way of creating a fertilizer industry. These small units can be gradually developed, particularly in the form of joint ventures.

Capacity utilization and rehabilitation of fertilizer plants

The effective utilization of existing capacity depends on simultaneous activities designed to improve a number of factors - infrastructure, manpower and production techniques. The first two factors, infrastructure and manpower, transcend the context of the plant and are discussed elsewhere. The point to be emphasized here is the importance of improving production techniques, for, as already noted, technical difficulties are responsible for the underutilization of capacity or the shutting down of many units.

For each fertilizer plant, a detailed study must be undertaken of the opportunities for improving the production process.

Plant and crop protection

The increased use of pesticides and herbicides is absolutely necessary to avoid the crop losses that make the use of fertilizers discouraging and pointless. These products are, however, expensive, unfamiliar and difficult to obtain. In view of the importance of the topic, it is covered separately at the Regional Consultation.

High-yield seeds

Several examples will suffice to show the importance of seed selection. In Kenya, 40 per cent of the maize plantations deliver 70 per cent of the total volume produced, thanks to the use by these plantations of an improved maize variety, the Kitale. Maize output has also been increased in Zimbawe through the introduction of the SR52 variety. In Zambia, better results have been achieved in wheat production through the use of a variety tolerating the presence of aluminium in the soil, while in Sudan, sorghum production has been boosted through the use of the Hareen Durra variety. Improved varieties of rhizomes and tubers are also producing good results (e.g. cassava).

Additional research and testing is necessary in view of the particular difficulties associated with African agriculture.

Agricultural implements and machinery

Fertilizer use cannot be increased to the required degree without the introduction of modern techniques, especially those that facilitate the spreading of fertilizers. It has been pointed out that one way of fostering the more extensive use of implements and machinery is through the formation of farmer associations. However, there must also be an increase in the local manufacture of agricultural equipment and in international assistance in this area. It is also necessary to train farmers in the proper use of the machinery and to furnish them with the means to operate the equipment effectively and to maintain it in a good state of repair (spare parts).

New types of fertilizers and application technologies

The use of traditional fertilizers, such as the organic manure obtained through the systematic recycling of crop residue, must be encouraged. But there must also be more research into developing new and innovative types of fertilizers. Certain of these are already in use in Africa, such as nitrogen-rich Azoll or, to a lesser degree, Rhizobia.

Progress in this area has been inhibited by shortcomings in research. The reasons for these deficiencies are to be found not only in sociological and economic factors, but also in the poor institutional organisation of fertilizer research. Although many different organisations are involved, their activities are not co-ordinated.

National and regional co-operation programmes should be set up with a view to co-ordinating the work of the different research centres. The aims should be to develop new fertilizers and new application technologies suitable for use in Africa.

Irrigation and water management

The first requirement for improving the irrigation systems is to collect comprehensive data on the current status of irrigation in Africa. It is judged that lasting improvement will critically depend on the following:

(a) Institutional reforms;

(b) The availability of new credit facilities;

(c) The purchase of additional equipment from abroad;

(d) Training for administrators, technicians, designers and maintenance personnel.

Depending on the situation, this may involve the rehabilitation of traditional or modern installations already in service or the building of new ones. Past experience, however, has shown that it is best to accord priority to projects that:

(a) Are inexpensive and not demanding in the way of investment and infrastructure;

(b) Require modest technical and managerial skills;

(c) Involve extensive participation by farmers;

(d) Fall within a collective framework along the lines, for example, of the approach adopted in Kenya (Provincial Irrigation Units).

3.3 Organizational considerations

It is important for African governments to formulate long-term contracts for fertilizer supply with producers. Today, bilateral agreements for trade in raw material and fertilizers (West African countries) enable the countries to go beyond the north/south traditional trade.

Africa is also confronted with the necessity of developing its own domestic markets to boost local production: Côte d'Ivoire, for example, could supply fertilizer simultaneously for its domestic markets and for the markets of Burkina Faso, Mali and Niger. Regional markets could be developed within the framework of African regional organizations (Common Africa and Mauritanian Organisation, Economic Community of West African States, Customs and Economic Union of Central Africa).

4. External assistance through international co-operation

This topic is covered under the Issue Paper II presented to the Regional Consultation.